Effect of Breathing Oxygen-Enriched Air on Exercise Performance in Patients with Chronic Obstructive Pulmonary Disease: Randomized, Placebo-Controlled, Cross-Over Trial

Hasler, Elisabeth Domenica ; Saxer, Stéphanie ; Schneider, Simon Raphael ; Furian, Michael ; Lichtblau, Mona ; Schwarz, Esther Irene ; Bloch, Konrad E ; Ulrich, Silvia

Abstract: Background: Patients with chronic obstructive pulmonary disease (COPD) experience dyspnea and hypoxemia during exercise. Objective: The aim of this study was to evaluate the effects of breathing oxygen-enriched air on exercise performance and associated physiological changes in patients with COPD. Methods: In a randomized, placebo-controlled, single-blind, cross-over trial, 20 patients with COPD (11 women, age 65 ± 6 years, FEV1 64 ± 19% pred., resting SpO2 90%) performed 4 cycle ergospirometries to exhaustion using an incremental exercise test (IET) and a constant work rate (at 75% maximal workload with air) exercise test (CWRET), each with ambient (FiO2 0.21) and oxygen-enriched (FiO2 0.5) air. The main outcomes were the change in maximal workload in the IET and the change in exercise duration in the CWRET with oxygen versus air. Electrocardiogram, pulmonary gas exchange, thoracic volumes by inductance plethysmography, arterial blood gases, and cerebral and quadriceps muscle tissue oxygenation (CTO and MTO) were additionally measured. Results: In the IET, maximal workload increased from 96 ± 21 to 104 ± 28 W with oxygen. In the CWRET, exercise duration increased from 605 ± 274 to 963 ± 444 s with oxygen. At end-exercise with oxygen, CTO, MTO, PaO2, and PaCO2 were increased, while V'E/V'CO2 was reduced and thoracic volumes were similar. At the corresponding time to end of exercise with ambient air, oxygen decreased heart rate, respiratory rate, minute ventilation, and V'E/V'CO2, while oxygenation was increased. Conclusion: In COPD patients without resting hypoxemia, breathing oxygen-enriched air improves exercise performance. This relates to a higher arterial oxygen saturation promoting oxygen availability to muscle and cerebral tissue and an enhanced ventilatory efficiency. COPD patients may benefit from oxygen therapy during exercise training.

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Effect of Breathing Oxygen-Enriched Air on Exercise Performance in Patients with Chronic Obstructive Pulmonary Disease: Randomized, Placebo-Controlled, Cross-Over Trial

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Abstract

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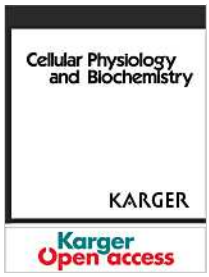

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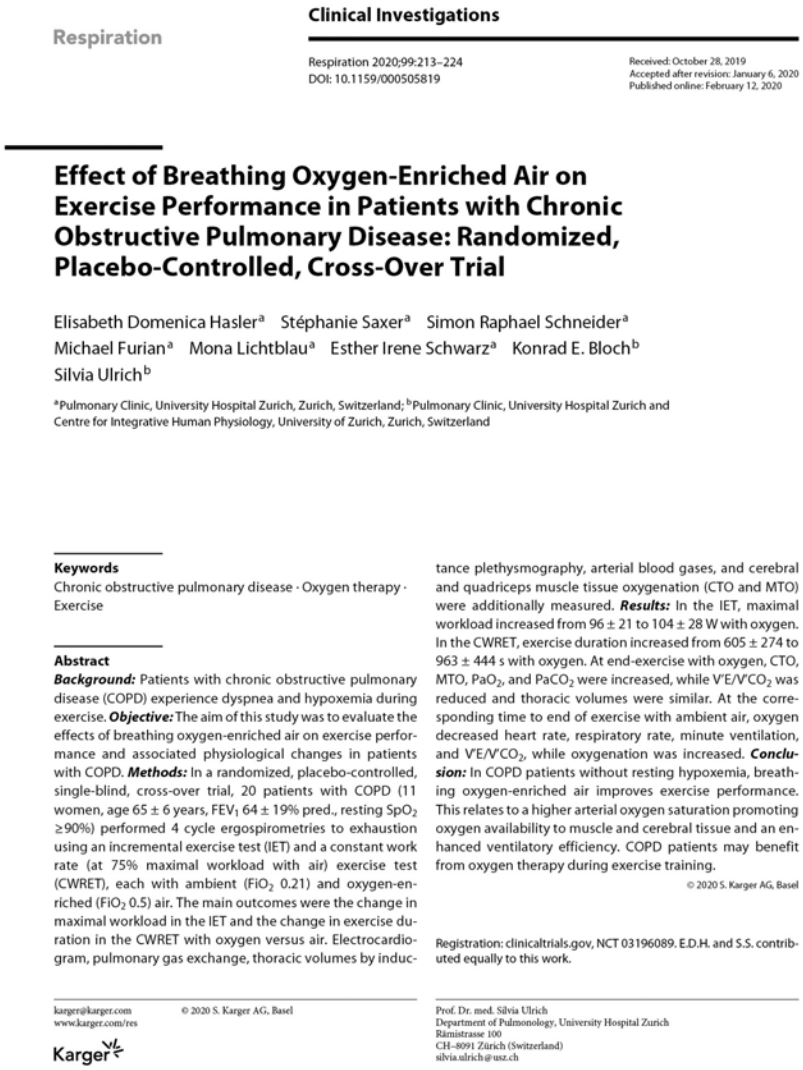

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Keywords
Chronic obstructive pulmonary disease · Oxygen therapy · Exercise

Abstract
Background: Patients with chronic obstructive pulmonary disease (COPD) experience dyspnea and hypoxemia during exercise. ***Objective:*** The aim of this study was to evaluate the effects of breathing oxygen-enriched air on exercise performance and associated physiological changes in patients with COPD. ***Methods:*** In a randomized, placebo-controlled, single-blind, cross-over trial, 20 patients with COPD (11 women, age 65 ± 6 years, FEV_1 64 ± 19% pred., resting SpO_2 ≥90%) performed 4 cycle ergospirometries to exhaustion using an incremental exercise test (IET) and a constant work rate (at 75% maximal workload with air) exercise test (CWRET), each with ambient (FiO_2 0.21) and oxygen-enriched (FiO_2 0.5) air. The main outcomes were the change in maximal workload in the IET and the change in exercise duration in the CWRET with oxygen versus air. Electrocardiogram, pulmonary gas exchange, thoracic volumes by inductance plethysmography, arterial blood gases, and cerebral and quadriceps muscle tissue oxygenation (CTO and MTO) were additionally measured. ***Results:*** In the IET, maximal workload increased from 96 ± 21 to 104 ± 28 W with oxygen. In the CWRET, exercise duration increased from 605 ± 274 to 963 ± 444 s with oxygen. At end-exercise with oxygen, CTO, MTO, PaO_2, and $PaCO_2$ were increased, while $V'E/V'CO_2$ was reduced and thoracic volumes were similar. At the corresponding time to end of exercise with ambient air, oxygen decreased heart rate, respiratory rate, minute ventilation, and $V'E/V'CO_2$, while oxygenation was increased. ***Conclusion:*** In COPD patients without resting hypoxemia, breathing oxygen-enriched air improves exercise performance. This relates to a higher arterial oxygen saturation promoting oxygen availability to muscle and cerebral tissue and an enhanced ventilatory efficiency. COPD patients may benefit from oxygen therapy during exercise training.

Registration: clinicaltrials.gov, NCT 03196089. E.D.H. and S.S. contributed equally to this work.

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